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ABSTRACT

This document presents a report from the Mathematics and Science Task Force. The Task Force held its initial meeting on January 27, 1999 to develop essential competencies in content knowledge and pedagogy in four areas: (1) elementary mathematics; (2) secondary mathematics; (3) elementary science; and (4) secondary science. Initially Task Force members identified issues and needs currently existing in elementary and secondary classroom environments, then they discussed and examined classroom observation programs required of students enrolled in education programs at the University of Wisconsin-Green Bay. Current curricular requirements in science and mathematics education programs at UW-Green Bay were also examined. (ASK)

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The Institute for Learning Partnership

Mathematics and Science Task Force Report

July 1999

UNIVERSITY of WISCONSIN
GREEN BAY

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The Institute for Learning Partnership

Mathematics and Science Task Force Report

University of Wisconsin–Green Bay

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Introduction to the Report of the Mathematics and Science Task Force

Meeting the Challenge Through a Regional Partnership

The place where this story begins is the University of Wisconsin–Green Bay and the time early in the fall semester of 1998.

Robert Wenger laid aside an article he was reading on the projected shortage of teachers in the field of science and mathematics. Although soon to retire after 30 years as a professor of Natural and Applied Sciences at UW–Green Bay, Wenger was still deeply involved in his field. What he read prompted him to make a telephone call across campus to Nancy Kaufman, Dean of Professional Studies and Outreach.

The conversation between Wenger and Kaufman focused on the article he was reading — a piece in the October 2, 1998, edition of the *Chronicle of Higher Education* titled "The Need for More Schoolteachers in Science and Math: How Colleges Can Help." It reported Robert Watson's prediction that public schools in the United States will need to hire 2.2 million teachers over the next decade to keep pace with rising enrollments and replace a generation of teachers about to retire. Preparing these teachers, Watson said, is the greatest challenge and responsibility faced by higher education today, and the need for improved education of teachers is particularly acute in science and mathematics.

Watson cautioned that the challenge not be left solely for departments of education. Because future teachers should major in the academic subject they want to teach, the course work they need in order to become competent in an academic subject should take place in colleges of arts and sciences. And that, Watson concluded, means faculty members in science and mathematics departments must be fully involved in teacher education programs at their institutions.

The convergence of Wenger, Kaufman and the Watson article was fortuitous. In fall 1998, the Northeast region of Wisconsin, where UW–Green Bay is located, was uniquely positioned for an effort focused on improving science and mathematics teacher preparation. In the preceding two years, a dynamic and widely-based coalition of business, community and education leaders had worked to establish a partnership dedicated to improving the quality of

learning at all levels. The partners were diverse — Cooperative Educational Service Agencies, regional school boards, PK-12 educators and administrators, the Wisconsin Education Association Council and WEA Professional Development Academy, representatives of the Partners in Education initiative operated through the Green Bay Area Chamber of Commerce, Northeast Wisconsin Technical College and regional business and community leaders, as well as UW–Green Bay. By early 1998 they had helped gain resources for a new effort that would be known as the Institute for Learning Partnership. Located at UW–Green Bay, the Institute was designed to serve a region covering more than 8,600-square-miles and having more than 7,600 teachers and 127,000 students in 63 public school districts. It was expected that even more districts would eventually be served.

Quick progress on several of the partners' goals contributed to the readiness of the University and other regional educators to address specific issues, such as the mathematics and science concerns that caught Wenger's attention. By 1998, a new master's degree in Applied Leadership for Teaching and Learning was approved for UW–Green Bay by the UW System Board of Regents. The degree program, designed to incorporate standards set by the National Board of Professional Teaching Standards (NBPTS), began enrolling students in fall 1998. With the encouragement of the Wisconsin Department of Instruction and regional school districts, the Institute introduced a Professional Development Certificate based on NBPTS standards. It was the first certificate program in the state to gain endorsement of the WEA Professional Development Academy. A school-based research component was established by the Institute to fund collaborative projects that would directly impact teaching and learning. And the University's undergraduate major in teacher education began preparing for the changes that would enable the program to address new Wisconsin standards.

Along with specific initiatives, the new Institute was ready to provide K-12 educators and University professors a forum for addressing mutual issues.

In the midst of this activity, Wenger and Kaufman continued their exploratory

discussion about teacher education with the University's Dean of Arts and Sciences, Carol Pollis, and a number of other mathematics and science faculty members. From these talks came the decision to create a Mathematics and Science Task Force. The group would be composed of both University faculty members and regional K-12 teachers. Its purpose would be to address the challenges spelled out in Watson's article.

The Task Force held its initial meeting on January 27, 1999. The charge to its members from Deans Kaufman and Pollis was "to develop essential competencies in content knowledge and pedagogy in four areas: elementary mathematics, secondary mathematics, elementary science and secondary science" with the understanding that their work could be informed by "standards developed by national associations as well as local school districts." (For the full memorandum and charge to the Task Force, see Appendix A. Among recipients of the memorandum, only Associate Professor Ted Korithoski was unable to accept the appointment.)

The seven-member Mathematics and Science Task Force met regularly throughout the 1999 spring semester and concluded its work in July 1999.

Identifying Issues and Needs

Early meetings were largely brainstorming sessions in which the Task Force members identified issues and the needs currently existing in elementary and secondary classroom environments. Wenger, who chaired the Task Force, cited the four K-12 teachers for their vital role in generating a number of stimulating conversations that helped to establish common ground for the group's subsequent activities.

Issues, needs and observations generated in these conversations included:

- Teachers must be prepared to implement standards and assessment criteria.
- More time is needed for pre-service teachers to observe and learn from live classroom situations.

- Teachers must be able to meet the needs of students who have a wide range of learning and physical disabilities.
- Teachers must be prepared to deal with legal issues and court challenges arising from standards-based education.
- The medical residency model with its lengthy internship program might serve as a more appropriate way to prepare teachers for the classroom.
- A heightened appreciation of a range of cultures, languages, and religions is needed in today's classroom.
- Important and significant school-to-work issues exist in today's schools — academic and vocational.
- Teachers need to understand the range of maturity levels which exist among today's students.
- Teachers need to be able to teach critical thinking skills, move beyond teaching methods which focus on routine problems, and incorporate conjectures into their teaching activities.

Examining Classroom Observation Programs

The Task Force discussed and examined classroom observation programs required of students enrolled in education programs at UW–Green Bay.

All of the K-12 teachers on the Task Force had been directly involved in classroom observation and student field experiences. All shared the view that while the programs are important in exposing education students to the "real world" of the classroom, they often lack quality. Among recommendations raised were the following:

- Criteria are needed which specify requirements and responsibilities.
- Students should be required to keep a journal.
- Students should be exposed to different teaching styles.
- Students should be required to make a real time commitment: a minimum of one hour is needed, a full day would be preferable.

- Students should present themselves professionally.
- Students should observe good teachers.
- Monetary or some other reward should be available to mentors.
- Observational activities should progress through several stages with different sets of outcomes.
- Education faculty members should be required to periodically experience K-12 classrooms and teach for extended periods — 9 to 12 weeks.

(See Appendix B for more complete discussions of this topic recorded by Task Force members Michael Berken, Julie Harris, Mary Kornely, and Wayne Olm.)

Identifying Knowledge, Skills and Competencies

The final major Task Force activity was an examination of current curricular requirements in science and mathematics education programs at UW–Green Bay. The review provided a framework for addressing the group's central charge of (1) identifying the knowledge and skills necessary to effectively teach mathematics and science and (2) developing corresponding sets of competencies to improve preparation of students in teacher education. The Task Force's work on these challenges constitutes the core of this report and is reported in full in pages 13 through 51.

The knowledge, skills and competencies which education students should possess at the conclusion of their undergraduate experience and before entering K-12 science and mathematics classrooms can be delineated in nine general categories:

- Mathematics or Science Content
- Technology
- Curriculum
- Teaching Strategies and Learning Styles
- Professional Development
- Classroom Management Strategies and Skills
- Assessment

- Standards-Based Education
- Education Partnerships

Working in subgroups, the Task Force formulated a specific list of competencies based on these nine general categories. Competencies were identified for each of the four programs: secondary mathematics, secondary science, K-8 mathematics and K-8 science. The list of competencies was then sent to a group of outside reviewers affiliated with schools and colleges around the state and elsewhere. Excerpts from reviewer comments appear at the end of each section. (See Appendix C for reviewers and their affiliations.)

Task Force Accomplishments Are Only the Beginning

This report of the Mathematics and Science Task Force is a beginning, not an end.

A subgroup of the Task Force met in summer 1999 to write a grant proposal to the Eisenhower Professional Development Program, which is supported by Title II of the 1994 Improving America's Schools Act. The proposal, based on some of the competencies identified by the Task Force, was one of 28 selected. The $159,941 grant is earmarked for development of instructional materials that integrate real-world issues and problems into the middle and high school science and mathematics curriculum. When the first phase of the project concludes in spring 2001, curricular material will be disseminated to regional teachers. While Task Force activities brought together school and campus partners, the Eisenhower project takes a step more by engaging community and industry representatives and teacher education students. (See Appendix D for the Eisenhower project abstract.)

In December 1999, Deans Kaufman and Pollis appointed a nine-member Mathematics and Science Alignment Task Force to recommend whether the University's education curriculum in these fields should be changed. The group's report was submitted in July 2000. (See Appendix E for an abstract of the Alignment Task Force report.)

The work does not end with math and science education, either. The Institute has scheduled a Language Arts Task Force for the 2000-2001 academic year, with Technology and Social Studies soon to follow.

The Report of the Mathematics and Science Task Force

Competencies for Education Students in Mathematics and Science

Secondary Mathematics Competencies

The specific education program to which this list of competencies applies is the Major in Mathematics/Teacher Certification in Secondary Education.

1. MATHEMATICS CONTENT

The secondary mathematics teacher will have successfully completed an undergraduate major in mathematics which leads to:

M1. A sound understanding of calculus: functions of a single variable to functions of several variables.

M2. A sound understanding of mathematical analysis, particularly as it illuminates the theory of calculus.

M3. A sound understanding of the basic concepts of ordinary differential equations.

M4. A sound understanding of algebra, including basic concepts from abstract algebra.

M5. A sound understanding of linear algebra.

M6. A sound understanding of Euclidean geometry and some non-Euclidean geometrics.

M7. A sound understanding of probability concepts and basic concepts from statistics.

M8. A sound understanding of concepts from discrete mathematics, including combinatorics and counting principles.

M9. A sound understanding of principles of mathematical modeling and the skills involved in applying mathematics to solve real world problems.

M10. An appreciation and understanding of the historical development of mathematical concepts and ideas.

M11. A sound understanding of mathematics as a creative endeavor which involves a search for patterns, formulation of conjectures, and construction of logical arguments based on careful and precise reasoning.

2. TECHNOLOGY

The secondary mathematics teacher will:

T1. Be skilled in the operation of graphing calculators, with an in-depth knowledge of at least one prominently used calculator.

T2. Be able to incorporate graphing calculators and Computer-Based Laboratories (CBLs) effectively in discovery/verification approaches to learning.

T3. Be able to use the Internet as a resource for lesson plans, information pertaining to mathematics education, and interesting real world applications of mathematics.

T4. Be familiar with several commercially produced computer software programs. These should include but not be limited to tutorial, exploration, and game-type programs. Included among these should be a statistical software package and a spreadsheet program.

T5. Be familiar with at least one of the high-level mathematics software packages such as *Derive*, *Maple*, and *Mathematica*.

T6. Be able to address educational and learning issues related to the appropriate use of technology in the mathematics classroom.

3. CURRICULUM

The secondary mathematics teacher will:

C1. Be familiar with the traditional sequence of the secondary mathematics curriculum, Algebra, Geometry, Algebra 2/Trigonometry, Pre-Calculus and its pertubations.

C2. Be familiar with the more recent integrated mathematics curriculum where the concepts of Algebra, Geometry, Algebra 2/Trigonometry are integrated along with Statistics, Probability, Logic, and Discrete Mathematics into a comprehensive three-year sequence. There are several standards-based reform curricular series now available which use this approach.

C3. Be completely aware of the state's standards for mathematics education and potentially mandated tests, and their implications for the mathematics curriculum.

C4. Be familiar with the NCTM (National Council of Teachers of Mathematics) standards for mathematics education.

C5. Realize the significant impact standards-based education has on their students, the curriculum, and their own careers. Internal accountability to high school principals and school districts has now been broadened to include external accountability to the state and agencies that provide funding.

4. TEACHING STRATEGIES AND LEARNING STYLES

The secondary mathematics teacher will:

TL1. Be familiar with a variety of teaching strategies to deliver mathematical concepts to students, including, but not limited to, the following:

- Lecture, teacher-led delivery of information.
- Discovery, teacher facilitates the discovery of a concept as the students perform a sequential set of tasks that lead to the discovery of a mathematical concept.
- Student explanations or presentations of problem solutions or concepts.
- Cooperative learning groups.
- Drill and practice.
- The use of writing as a component in the mathematics classroom
- Modeling, teacher- or student-led examples of the proper sequence of events that must take place in order to arrive at a solution.
- Risk taking, student awareness of trial and error and that solutions in mathematics can be arrived at in a variety of ways: creativity should be encouraged.

TL2. Be aware that students will learn in a variety of ways. They must deliver the curriculum knowing that some students may need more visuals, additional hands-on activities, more, or perhaps less, drill and practice. They must be aware some students are passive learners while others are active learners.

TL3. Be familiar with the educational research literature on the learning of mathematics and the information it provides concerning different learning styles.

TL4. Be familiar with gender equity issues in mathematics education and the specific need to encourage girls and women to study mathematics.

5. PROFESSIONAL DEVELOPMENT

The secondary mathematics teacher will:

P1. Be familiar with professional teaching associations that are available for membership. The Wisconsin Mathematics Council (WMC), National Council of Teachers of Mathematics (NCTM), and the Mathematical Association of America (MAA) are all outstanding organizations that provide valuable resources, conference and seminar opportunities, and opportunities to share teaching ideas with colleagues. The NCTM publications *The Mathematics Teacher* and the *NCTM Bulletin* are extremely valuable resources for the secondary mathematics teacher.

P2. Be required to become a member of the NCTM in the year he or she will be completing the student teaching assignment.

P3. Be required to attend a conference or seminar related to mathematics education at least twice while completing his or her secondary mathematics education program. The Green Lake Conference of the WMC in May and NCTM regional conference would provide excellent opportunities to fulfill this requirement.

6. CLASSROOM MANAGEMENT STRATEGIES AND SKILLS

The secondary mathematics teacher will:

CM1. Know how to create a quality classroom environment for learning mathematics.

CM2. Be prepared to deal with issues related to classroom attendance and absences and be knowledgeable about appropriate discipline strategies.

CM3. Be prepared to resolve conflicts or, at the very least, be able to quickly identify resources to help with conflict resolution.

CM4. Know how to keep careful records of student performance through the utilization of grade books, including computer grade books, as well as other classroom management capabilities software packages provide.

7. ASSESSMENT

The secondary mathematics teacher will:

A1. Be familiar with and know how to effectively utilize a variety of assessment methods: tests, portfolios, written papers, knowledge and concepts testing, performance tasks, and cooperative learning activities.

A2. Be fully aware of performance-based assessment and the use of rubrics.

8. STANDARDS-BASED EDUCATION

The secondary mathematics teacher will:

S1. Be knowledgeable about issues related to standards-based education within the State of Wisconsin and at the national level.

S2. Be prepared to incorporate learning strategies in the classroom, which creatively focus on student-centered educational values and objectives **and** address standards imposed from external sources.

9. EDUCATIONAL PARTNERSHIPS

The secondary education teacher will:

EP1. Be able to incorporate others in assisting student learning, most importantly parents/guardians.

EP2. Be able to utilize community resources in assisting with learning and classroom activities: community speakers, field trips, Golden Apple Academy, Einstein Academy, and the like.

EP3. Be aware of educational and professional resources available at local colleges and universities.

EP4. Be aware of opportunities in distance education in support of student learning and in-service educational activities.

Comments From Reviewers

Your group certainly did a super job of listing competencies for prospective secondary mathematics teachers.

> There should be a competency that addresses issues of gender equity and the shortchanging of female learners in a typical classroom.

I would expect that our students would be competent in representing mathematical problems using verbal, numerical, graphical, and analytical models and would be facile in going from one model type to another.

> I don't think there are even very many experienced secondary mathematics teachers that have mastered all the competencies identified in your document.

I commend you and UW–Green Bay for initiating this project. It is indeed a worthwhile undertaking.

> Again, I think your group is right on "the cutting edge." The world, especially Mathematics Education, is evolving very rapidly. What is needed in Mathematics Education today differs substantially from a decade ago and will be modified greatly in the next decade.

Overall, I feel this is a superb document which will serve as a guide for anyone wishing to experience an enjoyable, rewarding, and realistic career in teaching Secondary Mathematics. This thorough training can only lead the graduates of such a rigorous program to an extremely successful career in Mathematics Education.

K-8 Mathematics Competencies

The specific education programs to which the list of competencies apply are K-8 certification programs. All K-8 teachers should be challenged to meet these competencies. To be especially well-prepared, a prospective teacher should minor in mathematics.

1. MATHEMATICS CONTENT

The K-8 teacher will complete a set of courses in mathematics leading to:

M1. A sound understanding of the real number system, including whole numbers, integers, rational, and irrational numbers.

M2. A sound understanding of operations in the real number system.

M3. A sound understanding of order relationships and inequalities.

M4. A sound understanding of number-theoretic concepts: prime and composite numbers, greatest common factor, lowest common multiple, divisibility and remainders.

M5. A sound understanding of counting and estimating concepts.

M6. A sound understanding of basic geometric concepts: two- and three-dimensional figures and properties of such figures.

M7. A sound understanding of symmetry, congruence, similarity, and transformation.

M8. A sound understanding of measurement: exact vs. approximate, conversion from one system to another.

M9. A sound understanding of the basic concepts of statistics, their use in interpreting data and in developing and evaluating inferences, predictions, and arguments based on data.

M10. A sound understanding of chance and probability and the ability to apply these concepts to a variety of practical problems.

M11. A sound understanding of the use of symbolic forms to represent and analyze mathematical situations and structures.

M12. A sound understanding of the basic concepts of algebra.

M13. A sound understanding of the nature of mathematics: searching for patterns, formulating conjectures, constructing logical arguments, and engaging in careful reasoning processes.

M14. A sound understanding of problem-solving techniques in mathematics.

2. TECHNOLOGY

The K-8 teacher will:

T1. Have an understanding of appropriate and inappropriate use of calculators and computers in the learning of mathematics.

T2. Be skilled in the operation of graphing calculators.

T3. Be able to incorporate graphing calculators effectively in discovery/verification approaches to learning.

T4. Be able to utilize computing resources including the Internet, as a resource for lesson planning, information pertaining to mathematics education, and interesting real world applications of mathematics.

T5. Be able to address educational and learning issues related to the use of technology in the mathematical classroom.

T6. Be familiar with commercially produced computer software programs. These should include but not limited to tutorial, exploration and game-type programs.

T7. Be able to operate effectively a large range of audio-visual and multi-media equipment.

3. CURRICULUM

The K-8 teacher will:

C1. Have a thorough understanding of standards-based learning and its implications in the mathematics curriculum.

C2. Be completely aware of the WSAS (Wisconsin Student Assessment System) tests, based on the state's standards and what impact they will have on the curriculum, the teacher, and the student.

C3. Be familiar with the NCTM (National Council of Teachers of Mathematics) standards for mathematics education.

C4. Become familiar with current mathematics textbooks and publishers.

C5. Be able to incorporate mathematics learning into cross-curricular activities.

4. TEACHING STRATEGIES AND LEARNING STYLES

The K-8 teacher will:

TL1. Have the ability to develop different teaching strategies to meet various learning styles of students.

TL2. Be prepared to utilize a variety of learning resources outside the classroom.

TL3. Be prepared to deal with different levels of maturity and a wide age span of the students in a classroom.

TL4. Embrace the principle that mathematics instruction should promote the learning of mathematics by **all** students, including those with special needs.

TL5. Be familiar with a variety of teaching strategies to deliver the mathematical concepts to their students. Including but not limited to the following:

- Lectures, teacher-led delivery of information.
- Discovery, teacher facilitates the discovery of a concept as the students perform a sequential set of tasks that lead to the discovery of a mathematical concept.
- Student explanations or presentations of problem solutions or concepts.
- Cooperative learning groups.
- Drill and practice.
- The use of writing as a component in the mathematics classroom.
- Modeling, teacher- or student-led examples of the proper sequence of events that must take place in order to arrive at a solution.
- Risk taking, student awareness of trial and error and that solutions in mathematics can be arrived at in a variety of ways: creativity should be encouraged.

TL6. Have a sound understanding of manipulatives and ways they can be used to aid in the learning of mathematics.

TL7. Be able to teach problem solving skills.

TL8. Be able to move from theory to practice with mathematical concepts, i.e., translate theoretical concepts into practical classroom activities.

TL9. Be familiar with educational research on children's learning of mathematics.

TL10. Be prepared to face and respond to rapid changes in the educational scene.

5. PROFESSIONAL DEVELOPMENT

The K-8 teacher will:

P1. Be familiar with professional teaching associations that are available for membership such as The Wisconsin Mathematics Council (WMC) and the National Council of Teachers of Mathematics (NCTM). Two NCTM publications which are particularly useful to teachers at this level are: *Teaching Children Mathematics* and *Mathematics Teaching in the Middle School.*

6. CLASSROOM MANAGEMENT STRATEGIES AND SKILLS

The K-8 mathematics teacher will:

CM1. Be knowledgeable about appropriate discipline strategies to be used in the mathematics classroom.

CM2. Be prepared to deal with issues related to classroom and school procedures, including but not limited to the following:

- Attendance and lunch procedures.
- Hallway and classroom behavior.
- Lesson planning procedures.
- Recording and reporting of grades.
- Parent communications.
- Faculty and committee work.
- Dealing with integration of Special Needs Children in the regular education classroom.
- Other liabilities that are job related.

7. ASSESSMENT

The K-8 teacher will:

A1. Be familiar with and know how to effectively utilize a variety of assessment methods: tests, portfolios, written papers, knowledge and concepts testing, performance tasks, daily work and cooperative learning activities.

A2. Be able to address the philosophical issues related to the use of technology in the mathematics classroom.

8. STANDARDS-BASED EDUCATION

The K-8 teacher will:

S1. Be knowledgeable about issues related to standards-based education within the State of Wisconsin and at the national level.

S2. Be prepared to incorporate learning strategies in the classroom which creatively focus on educational values and objectives and address standards imposed from external sources.

S3. Be prepared to be accountable for the curriculum choices made at the present time and in the future.

9. EDUCATIONAL PARTNERSHIPS

The K-8 teacher will:

EP1. Be able to incorporate others in assisting student learning, most importantly parents/guardians.

EP2. Be able to utilize community resources in assisting with learning and classroom activities: community speakers, field trips, Golden Apple Academy, the Einstein Academy, and the like.

EP3. Be aware of resources available at local colleges and universities.

EP4. Be aware of opportunities in distance education in support of student learning and in-service educational activities.

Comments From Reviewers

The most important competency in my mind is that education students who plan to teach mathematics at the elementary level understand the *nature of mathematics*, that they see mathematics as a search for patterns, making conjectures, making arguments, and reasoning.

The elementary teacher must be able to provide opportunities for learning mathematics in a cross-curricular context.

I think you have done a marvelous job of establishing a set of rigorous goals.

Secondary Science Competencies (Biology and Chemistry)

Rather than attempting to cover all areas of science, the Task Force focused on Biology and Chemistry. Thus, the specific education programs to which the list of competencies applies are the Major in Biology/Teacher Certification in Secondary Education and the Major in Chemistry/Teacher Certification in Secondary Education. Many of the competencies — particularly those in the non-content categories — also apply to other areas of science.

1. SCIENCE CONTENT

The secondary biology teacher will have successfully completed an undergraduate major in biology which leads to:

B1. The ability to model and emphasize the skills, attitudes and values of scientific inquiry.

B2. A sound understanding of the interactions of science, technology and society.

B3. A sound understanding of individual and social perspectives on science.

B4. A sound understanding of the history and nature of science.

B5. A knowledge of the diversity and unity that characterize life in the six kingdoms of living organisms.

B6. A sound understanding of the genetic basis for the transfer of biological characteristics from one generation to the next.

B7. A sound understanding of the general structure and functions of cells in organisms.

B8. A sound understanding of how species depend on one another and on the environment for survival.

B9. A sound understanding of ecological principles, the cycling of matter and flow of energy through the living environment.

B10. A sound understanding of the basic concepts of the evolution of species.

B11. Proficiency in the use of mathematics/statistics for analyzing and understanding scientific data. This requires the completion of undergraduate coursework in calculus and statistics.

The secondary chemistry teacher will have successfully completed an undergraduate major in chemistry which leads to:

C1. The ability to model and emphasize the skills, attitudes and values of scientific inquiry.

C2. A sound understanding of the interactions of science, technology and society.

C3. A sound understanding of individual and social perspectives on science.

C4. A sound understanding of the history and nature of science.

C5. A sound understanding of the cycling of matter and flow of energy through the living and non-living environment.

C6. A sound understanding of the basic concepts about the structure and properties of matter.

C7. A sound understanding of energy types, sources and conversions and their relationship to heat and temperature.

C8. Knowledge of the kinds of forces that exist between objects and within atoms.

C9. Proficiency in the use of mathematics/statistics for analyzing and understanding scientific data. This requires the completion of undergraduate coursework in calculus and statistics.

2. INQUIRY

In order to effectively implement scientific inquiry in the classroom, the secondary science teacher should have the experience of conducting at least one semester's worth of work on an independent study project (bench-work experimentation and/or field work) in his/her subject area at the undergraduate level. This experience will provide the secondary science teacher with the ability to do the following in the classroom:

I1. Identify questions and concepts that guide scientific investigations.

I2. Design and conduct scientific investigations.

I3. Use technology and mathematics as basic tools in investigating and communicating scientific information.

I4. Formulate and revise scientific explanations and models using logical reasoning and evaluation of evidence.

I5. Recognize and analyze alternative explanations and models.

I6. Communicate and defend a scientific argument.

3. TECHNOLOGY

The secondary science teacher will:

T1. Be able to use the Internet as a resource for lesson plans, information pertaining to science education and interesting real world applications of science.

T2. Be competent in the use of computer software and hardware to perform laboratory investigations involving the collection of data.

T3. Be able to engage students in a scientifically-informed discussion of current issues involving technology, its philosophical and practical applications, and the consequences of its use.

T4. Know and be able to apply the necessary safety regulations in the use, storage and care of materials and equipment used by students.

In addition, the secondary biology teacher will:

T5. Be skilled in the operation and maintenance of basic pieces of laboratory equipment, including but not limited to the following: pH meters, thermometers, electronic computer interface (including digital equipment), autoclaves, microscopes, balances, incubators, water baths, electrophoresis equipment (gel boxes, power supplies), centrifuges, pipettes.

T6. Possess a basic knowledge of principles and techniques in molecular biology (tools which are now applicable to every biological field). This requires completion of an undergraduate course and laboratory in molecular biology or recombinant DNA techniques.

T7. Be competent in cell culture technology (both prokaryotic and eukaryotic), a fundamental strategy for addressing scientific questions.

T8. Be skilled in the use and maintenance of basic types of equipment for conducting field work.

In addition, the secondary chemistry teacher will:

T9. Be skilled in the operation and maintenance of basic pieces of laboratory equipment, including but not limited to the following: pH meters, thermometers, UV-visible spectrophotometers, balances, centrifuges, pipettes.

4. CURRICULUM

The secondary science teacher will:

CU1. Be familiar with the traditional sequence of the secondary science curriculum (physical science, biology, chemistry and physics).

CU2. Work together with colleagues within and across disciplines to construct coherent and articulated science programs within and across grade levels.

CU3. Be familiar with local, state and national standards on science education and plan and teach lessons that meet those standards.

CU4. Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities and experiences of individual students.

CU5. Develop a framework of year-long and short-term goals for students and communicate these goals with students.

5. TEACHING STRATEGIES AND LEARNING STYLES

The secondary science teacher will:

TL1. Recognize and respond to student diversity and encourage all students to participate fully in science learning.

TL2. Use strategies which address gender equity issues and be aware of the specific need to encourage girls and women to study science.

TL3. Be familiar with a variety of teaching strategies to deliver science concepts to students, since students learn in a variety of ways. Includes but is not limited to the following:

- Discovery: teacher facilitates the discovery of a concept as the students perform a sequential set of tasks that leads to the discovery of a science concept.
- Cooperative learning groups.
- Student explanations or presentations of problem solutions or concepts.
- Risk-taking: student awareness of trial and error. Solutions in science can be arrived at in a variety of ways. Creativity should be encouraged!
- Use of writing as a component in the science curriculum.
- Lecture: teacher-led delivery of information.

TL4. Challenge students to accept and share responsibility for their own learning.

TL5. Orchestrate discourse among students about scientific ideas.

TL6. Be familiar with the educational research literature on the learning of science and the information it provides concerning different learning styles.

6. PROFESSIONAL DEVELOPMENT

The secondary science teacher will:

PD1: Understand how to write and will have written a vocational mission statement.

PD2: Be familiar with professional teaching associations that are available for membership: NEW Science Forum, Wisconsin Society of Science Teachers (WSST), National Education Association (NEA), National Association of Biology Teachers (NABT), American Chemical Society (ACS), National Science Teachers Association (NSTA).

PD3. Be required to attend a conference or seminar related to science education at least twice while completing his or her secondary science education program.

PD4. Be aware that professional development is a career-long process and requires active participation in educational opportunities available through local colleges and universities and professional teaching and/or science organizations.

7. CLASSROOM MANAGEMENT STRATEGIES AND SKILLS

The secondary science teacher will:

CM1. Be able to write a set of "classroom expectations"— a document that integrates the school district's policies and the teacher's personal policies on classroom management issues.

CM2. Display and demand respect for the diverse ideas, skills and experience of all students.

CM3. Be able to provide a classroom and laboratory environment that is physically and emotionally safe for all students.

CM4. Be able to use a variety of methods to inspire student interest, learning and effort.

CM5. Be able to appropriately and effectively communicate with parent(s) and or guardian(s), working with them as partners in the educational process.

CM6. Be able to demonstrate appropriate discipline strategies for the science classroom.

CM7. Be prepared to deal with issues related to classroom attendance and absences, budgets, educational liability issues, and contractual obligations.

CM8. Know how to keep careful records of student performances through the utilization of grade books (including computer grade books).

8. ASSESSMENT

The secondary science teacher will:

A1. Be familiar with and know how to effectively utilize a variety of methods to assess student ability and learning (e.g., tests, portfolios, written papers).

A2. Analyze assessment data to guide teaching.

A3. Use student data, observations of teaching and interactions with colleagues to reflect on and improve teaching practice.

9. STANDARDS-BASED EDUCATION

The secondary science teacher will:

S1. Be knowledgeable about issues related to standards-based education within the State of Wisconsin and at the national level.

S2. Be prepared to incorporate learning strategies in the classroom which creatively focus on educational values and objectives **and** address standards imposed from external sources.

10. EDUCATIONAL PARTNERSHIPS

The secondary science teacher will:

EP1. Be able to incorporate others in assisting student learning, most importantly parent(s)/guardian(s).

EP2. Be able to utilize community resources in assisting with learning and classroom activities: community speakers, field trips, Golden Apple Academy, and the like.

EP3. Be aware of resources available at local colleges and universities, museums, and libraries.

EP4. Be familiar with the academic needs of students on different academic tracks (e.g., those entering the work force immediately, those attending technical schools, those attending traditional colleges).

EP5. Be aware of the importance of establishing ties or contacts with professionals in the field who may offer internships or career counseling to students (e.g., individuals working for pharmaceutical companies or workers in the field of health care).

Comments From Reviewers

Overall, a very comprehensive plan with much foresight for science education teachers. Thanks for the opportunity to comment.

> The base pay of a teacher possessing all of these competencies should be $40,000!

[We must] emphasize the need for students to continue [professional development activities] when they are practicing teachers!

> Thank you for the opportunity to review this document. Exercises like this help me refocus and reflect on our profession.

K-8 Science Competencies

The specific education programs to which this list of competencies apply are K-8 certification programs. All K-8 teachers should be challenged to meet these competencies. To be especially well-prepared, a prospective teacher should minor in science.

For elementary teachers to effectively teach science at the K-8 level, they must appreciate and understand science as a human endeavor which incorporates the following:

- The possibilities and limitations of science.
- The interactions between science and society.
- How various kinds of scientists obtain and use information.
- The need for integrity in science.

1. CONTENT

The K-8 teacher will have a sound understanding of the following subject matter:

Earth Science

ES1. Structure of the Earth — Three basic types of rocks and how they are formed. How to classify rocks and be able to identify several simple types of rocks that are found in the local area.

ES2. History of the Earth — Major events from Precambrian to current times. Identify fossils that have local significance and understand principles of geologic dating.

ES3. The nature of catastrophic events such as earthquakes, volcanos, tidal waves, and avalanches.

ES4. The characteristics of the basic structures in the universe such as galaxies, stars, planets, moons, asteroids, comets, and meteoroids.

ES5. The nature of time, seasons, lunar events.

ES6. The structure of the oceans and the biological life in the oceans and freshwater environments.

ES7. The basic elements of weather and climate, the hydrologic cycle, the nature of local weather patterns.

Biology

B1. The major categories of living organisms and their basic structures and functions.

Animals: Microorganisms, insects, reptiles, fish, amphibians, birds, and mammals.

Plants: Microorganisms, grasses, trees, flowering plants, sources of food, and building materials.

B2. The basic needs of living organisms and energy flow in the natural system.

B3. Basic genetics and reproduction in plants and animals.

B4. Ecological relationships.

B5. Human anatomy, physiology, and health care needs.

B6. The importance of various plants and animals to the local community.

Chemistry

C1. The nature and structure of matter which includes the different forms of matter, the characteristics of solids, liquids, and gases, and simple models of chemical bonding.

C2. Understand simple chemical reactions and equations that involve acids, bases, and salts.

C3. Simple oxidation reduction reactions and their applications in batteries, electroplating, and natural systems.

C4. Basic organic chemistry as it relates to nutrition, synthetic fibers, genetics, other real world applications.

C5. How to use simple laboratory equipment and make simple measurements of mass and volume.

C6. Be able to identify simple substances by their easily measurable chemical characteristics.

C7. Know how chemical reactions generate and utilize energy.

Physics

P1. Linear motion and acceleration.

P2. Force and gravity.

P3. Work, mechanical advantage, and simple machines.

P4. Rotary motion.

P5. Fluids, displacement, and Bernoulli's Principle.

P6. The nature of heat, heat transfer, and heat and work.

P7. The nature and characteristics of longitudinal and transverse waves.

P8. Sound frequency and loudness.

P9. Static electricity.

P10. Current electricity, simple circuits, voltage, current, and resistance.

P11. Electricity and magnetism, simple electric motors and generators.

P12. Light reflection, refraction, mirrors, lenses, and polarized light.

P13. The nucleus of the atom, applications and hazards of atomic energy, and nuclear radiation.

2. EXPERIENCES

In a world that is growing increasingly dependent on the contributions of science, science literacy is an important educational goal for the individual student and one which enhances the cultural diversity of students. Students learn science concepts most effectively when they explore concrete examples of these concepts. They need to investigate and have hands-on experiences. Therefore, the K-8 teacher will be able to:

E1. Provide motivation — a reason and desire for learning.
- Provide hands-on activities and have background information to relate activity to the real world.

E2. Look at the science curriculum, develop a depth of understanding and make science exciting for the student.
- Be knowledgeable about science "tools," equipment, supplies and how to use them safely.

E3. Modify content/activities for special-needs students.
- Provide experience with life, physical and earth sciences.

E4. Use a variety of resources (library, Internet, colleagues, textbooks, insights gained from science seminars, experience from involvement in district science committees and job-alike classes pertaining to science.)

E5. Correlate science with other subject areas: literature, mathematics, cultural connections, the arts, technology, social studies, and language arts.

E6. Reflect on, evaluate, and modify program activities throughout the year.

3. SKILLS

The K-8 science teacher will be able to provide Process Skills, Critical Thinking Skills, Scientific Reasoning Skills, Creative Thinking and Common Themes.

S1. **Process examples** include: observing, classifying, communicating, inferring, predicting, collecting-recording-interpreting data, formulating hypotheses, experimenting, constructing, and using models; in short, the elements of the scientific method.

S2. **Critical Thinking examples** include: analyzing, synthesizing, evaluating, applying, generating ideas, expressing ideas and solving problems.

- Show relationships/recognize relationships.
- Transfer, information, skills, processes.

S3. **Reasoning examples** include: desire to know and understand, questioning scientific assumptions, searching for data and its meaning, demanding verification, and considering consequences.

- Experiment and analyze information gained from successes and failures.

S4. **Creative Thinking examples** include: generating, trusting, maintaining one's own standards of evaluation, generating new ways of viewing a situation outside the boundaries of standard convention, e.g., electric cars, solar cars.

4. THEMES

Prospective teachers will understand the big ideas contained in the **Common Themes of Science**. Themes such as **Systems**, **Models**, **Constancy and Change**, and **Scale** are evident in science and should be recognized. Brief descriptions are:

T1. **Systems** — Body systems, the system created as matter and energy interact, and interactions of living and non-living components of ecosystems.

T2. **Models** — Models of atoms and computer simulations. Models are used to think about processes that happen too slowly, too quickly or occur on a scale too large or small to be directly observed.

T3. **Constancy and Change** — Predator-prey relationships, the idea of conservation of matter and energy, and the continuous cycling of matter and energy in nature.

T4. **Scale** — study parts of a system, the effects of changing variables in equations and comparisons of size and distance within systems.

Comments From Reviewers

This looks great! Very clearly explained; easily understood. I'm assuming the science methods class would *enable the prospective teachers* by creating practical lessons to attain these competencies.

> This looks great. I hope it is understood that all of this takes time and does not happen overnight!

Good work.

> OK as is! Good job!

Looks good! Thanks for doing this. I'm sure college students will appreciate this.

> Looks like a good plan as is.

The most important theme found throughout the lists of competencies is that education students who are prepared to enter K-12 science and mathematics classrooms will be thoroughly grounded in the subject matter they plan to teach.

At the secondary level this means students who plan to teach mathematics will complete an undergraduate major in mathematics, students who plan to teach biology will complete an undergraduate major in biology, students who plan to teach chemistry will complete an undergraduate major in chemistry, and so on. At the elementary level, students who plan to specialize in the teaching of mathematics or science will complete a minor in mathematics or a minor in one of the sciences, respectively.

Recent articles and reports on the current state of K-12 education—the article by Watson cited at the beginning of this report among them—have emphasized that to improve educational quality teachers must be well-trained in and enthusiastic about the subjects they teach. In an article titled "Good Teaching Matters ... A Lot," Kati Haycock addresses the importance of deep content knowledge as a factor that makes for an effective teacher. According to Haycock, who is director of The Education Trust: "There is ... considerable research showing how important teachers' content knowledge is to their effectiveness with students, especially at the middle and senior high school levels. The data are especially clear in mathematics and science where teachers with majors in the fields they teach routinely get higher student performance than teachers who do not .... we suggest that educational leaders not get sidetracked: there is more than sufficient evidence about the importance of deep content knowledge and strong verbal skills to serve as a foundation for immediate action."

A second important theme common to the lists of competencies developed by the Mathematics and Sciences Task Force is technology.

Those who plan to enter today's and future K-12 classrooms to teach mathematics or science must be able to confidently and effectively use computing resources in both teaching and classroom management activities. Computing

resources include computers, with their accompanying software and Internet capabilities, and graphing calculators. Effective use of these resources means that teachers have a command of the technical aspects of computer and calculator use and are able to carefully incorporate them into classroom teaching activities based on overall learning objectives.

A recent report on the preparation of teachers for a digital age — "Will New Teachers be Prepared to Teach in a Digital Age?" — states that, in general, teacher-training programs do not provide future teachers with the kinds of experiences necessary to prepare them to use technology effectively in their classrooms. A challenge, then, to teacher education programs is to find ways to provide these types of experiences. In addition, all teachers must be skilled in the use of audio-visual and multi-media equipment.

The effective use of technology is embedded in a larger theme common to all of the competency lists: the resourceful use of a wide range of resources as aids to student learning. These resources include people (parents/guardians, colleagues, community persons) and community linkages through field experiences and through the use of available expertise. In Northeast Wisconsin, examples include the Golden Apple Academy and Einstein Academy, among others.

In their report, "Preparing Schools and School Systems for the 21st Century," a study group of 21 leaders from business, education, government, and other fields, make the same point by redefining "school." The authors note, "In the past, a 'school' was generally defined as a building. In the 21st century, schools will become nerve centers, with walls that are porous and transparent connecting teachers, students and the community to the wealth of knowledge that exists in the world. Schools in the 21st century will not be confined by their walls but will be encompassing of the entire community and the world."

A fourth theme is the need for those who would be future teachers to be prepared to incorporate various types of teaching strategies in their classrooms. Students learn in different ways and at different paces. Therefore, to

enable all students to enhance their understandings of science and mathematics, teachers need to serve as orchestrators of learning, not merely as dispensers of information. Their teaching strategies must be buttressed with the knowledge provided by educational research concerning the different learning styles employed by students in learning science and mathematics.

Along with the development of effective teaching strategies, teachers must be familiar with a variety of methods for assessing student learning.

A knowledge of the curriculum and curricular issues constitute a fifth theme present in all of the competency lists. Teachers must be aware of the larger curriculum within which their specific courses or classroom activities are embedded, and also must understand the external forces which have a bearing on curricular matters. Specifically, teachers must be fully aware of standards-based educational requirements and performance-based testing imposed by states and other agencies, and the implications of these forces for the curriculum.

Finally, new teachers stepping into the classroom must be cognizant of the fact that learning how to be an effective teacher has only begun with the complètion of their teacher education and certification programs. Professional development activities must be a constant part of their careers as teachers. They need to be open to and learn from the accumulated wisdom of colleagues, gain insights from their involvement in professional teaching associations, and participate in a variety of in-service activities in order to stay abreast of the dynamic education profession and, also, to grow as teachers.

In addressing its charge, the Mathematics and Science Task Force has identified competencies and skills that are necessary for education students to become effective teachers of mathematics or science in K-12 classrooms. These competencies deal primarily with intellectual capabilities and pedagogical skills. As such they tend to focus on "technique."

It is important to note that the development of good "technique" is a necessary condition for teaching success, but, at the same time, it is not sufficient.

Conclusion

Parker Palmer, in his book *The Courage to Teach*, says, "Good teaching cannot be reduced to technique; good teaching comes from the identity and integrity of the teacher." He goes on to discuss the need for educational institutions to find ways to sustain and deepen the selfhood of those preparing to teach and to nurture their inner ground from which good teaching comes. An understanding of selfhood and personal integrity are attributes needed if teachers are to create space in which student learning can occur.

In helping education students develop the craft of teaching, it is important that they be exposed to good teaching. This must occur not only in their educational courses but also in their "content" courses. Thus, faculty throughout the University have an important role to play in preparing students to become teachers of quality in K-12 classrooms.

At one level, all who are part of the education enterprise know this, but it is important that faculty in the arts and sciences engage in regular dialogue about curricular and developmental needs of students in education. Thus, at the University of Wisconsin–Green Bay the results of this Task Force will be shared with faculty in mathematics and the sciences. The need for all institutions in higher education to find ways to improve and demonstrate the quality of their teacher education programs would never seem to be more important.

A recurring theme at the recent annual conference of the Education Commission of the States held in Denver, Colorado, was that the quality of teacher education is likely to become a key measure for how lawmakers will judge colleges and universities. This was stated succinctly by a conference speaker who said: "The quality of the institution is now, and increasingly will be, judged by the quality of its teacher education, more so even than by its research or scholarship, because teacher education is and will continue to be a high profile topic."

In compiling the competency lists that make up this report, the Task Force consulted, but did not replicate, nor was it constrained by, the work done by others in external projects with similar objectives, e.g., *Wisconsin's Model*

Academic Standards or *The Principles and Standards for School Mathematics Project* under the aegis of the National Council of Teachers of Mathematics. The Task Force felt it was important to focus attention on those things which are essential if teachers are to assist their students in becoming educated persons, in being able to make sense of the world and to act within it in creative ways. Despite the independence of the Task Force's work from similar external projects, a number of conclusions tend to be common to both. Those who use the findings contained in this report are encouraged to consult and study the findings from other projects, such as those mentioned above.

In conclusion, the Task Force offers a statement from "Preparing Schools and School Systems for the 21st Century:"

> Teachers must be the brightest and best society has to offer; they must believe in themselves and their contribution to students and society; yet they must be constantly committed to improving, no matter how good they are ... we need to be sure we offer lifelong learning for our teachers, as well. Our teachers need to be catalysts in setting a culture of academic excellence.

A daunting challenge, indeed, but most certainly one capable of inspiring faculty and students.

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Appendices

A. Memorandum Containing Task Force Charge

B. Recommendations for Classroom Observation Programs

C. Outside Reviewers

D. Eisenhower Project Abstract

E. Alignment Task Force Abstract

Appendix A: Memorandum Containing Task Force Charge

OFFICE OF THE ACADEMIC DEANS

January 20, 1999

MEMORANDUM

TO: Angie Bauer-Dantoin, professor, UW–Green Bay
Mike Berken, secondary math teacher, Pulaski High School
Mary Kornely, elementary teacher, Denmark Elementary School
Julie Harris, elementary teacher, Green Bay
Ted Korithoski, professor, UW–Green Bay
Wayne Olm, secondary science teacher, Green Bay Preble High School
Tom Van Koevering, professor, UW–Green Bay
Robert Wenger, professor, UW–Green Bay

FROM: Nancy J. Kaufman, Dean, Professional Studies and Outreach
Carol Pollis, Dean, Liberal Arts and Sciences

RE: Appointment to the Mathematics and Science Task Force

Thank you for agreeing to serve on the Mathematics and Science Task Force. The first meeting will be held on Wednesday, January 27 from 4:00-5:00 p.m. in 317 Environmental Sciences.

The charge to the Task Force is to identify the knowledge and skills that are necessary to effectively teach mathematics and science and to develop a corresponding set of competencies that can be used to improve preparation of students in our teacher education program. Our goal is to ensure that all of our prospective teachers are provided with a sound undergraduate program in mathematics and science that effectively prepares them to teach in the K-12 schools.

We would like you to develop essential competencies in content knowledge and pedagogy in four areas: elementary mathematics, secondary mathematics,

elementary science and secondary science. Your work can be informed by standards developed by national associations as well as local school districts. Professor Robert Wenger has agreed to chair the Task Force. We have asked him for a report from the group by the end of the spring semester.

The academic programs in Education, Science and Mathematics at UW-Green Bay are committed to continuously improving the preparation of prospective teachers. The work of this Task Force will be an important part of the process, and we greatly appreciate your willingness to contribute your time and expertise.

cc: Howard Cohen, Provost
Francine Tompkins, Chair, Teacher Education

Appendix B–1: Recommendations for Classroom Observation Programs

Mathematics and Science Task Force

University of Wisconsin–Green Bay

Mary Kornely

March 10, 1999

From UW–Green Bay:

Design specific criteria for what the student is to accomplish: (example)

- Number of hours to be spent observing.
- Number of hours to be spent working directly with students.
- Journal of observations.
- Provide the classroom teacher with criteria.

From Classroom Teacher:

- Provide and model a variety of teaching styles.
- Provide copies of curriculum and classroom procedures.
- Provide group experiences.
- Find time to discuss lessons/curriculum.

From Student:

- A commitment to be in the classroom
- At specific times for the 30 hours (mutually agreed upon times with teacher)
- At least 1-hour visits—half-days would be ideal
- Present themselves professionally
- Show willingness to learn and teach

Appendix B–2: Recommendations for Classroom Observation Programs

March 10, 1999

University of Wisconsin–Green Bay Science and Math Task Force
Mike Berken
Pulaski High School

Current education certification programs require up to 100 hours of field experiences prior to a student teaching assignment. This Task Force has some concerns over the quality of these clinical/observation hours. I asked some of my colleagues for their opinions. I included a blend of experienced teachers as well as some teachers that are new to the profession. I felt the younger teachers that are not that far removed from their own certification programs may have some valuable insight now that they have been teaching for a couple of years. The following list presents my views as well as those of my colleagues.

- The large amount of time is an excellent idea as long as the experiences are varied and meaningful. The observation requirements should be spread out over several university classes. Each class that has a clinical/observation requirement should be very specific as to what the outcomes are to be.
- The clinical/observation hours should be very well structured. The cooperating teacher and the student should be informed of the desired outcomes of the observation experience. Structure is so important to insure the quality of the experience, if the experience is well defined in terms of the outcomes the student won't feel like they are being asked to "jump through hoops" before they are allowed to student teach.

A possible 10-hour observation requirement may consist of:

3 hours of direct observation

2 hours of grading papers

2 hours of tutoring individual students or small groups of students

1 hour discussing a lesson with the teacher

1 hour preparing the lesson

1 hour presenting the lesson to the class

The next observation/clinical experience could have a completely different set of outcomes.

- Some of the clinical/observation hours should be for extended periods of time. The student should spend an entire day with the cooperating teacher. One hour a day of observation for 10 weeks in my calculus class does not give a true picture of my day.
- The clinical/observation hours should include time spent observing and working with students of various ability levels.
- The experience should involve activities that allow the student to see the whole child.
- The experience should allow the student to get an indication of the time, energy and dedication that is required to be a successful educator.
- The clinical/observation hours should expose the student to all the age groups this certification is going to include.
- The quality of the experience is so dependent on the cooperating teacher. The University could set up a partnership with a group such as the Golden Apple Academy of Green Bay.
- The clinical/observation time is overloaded with too much observation time. In order to make the experience more beneficial we should get the potential teachers planning lessons, working with students and perhaps teaching a little.

- As the student progresses through a teaching certification program the clinical/observation requirements could become more involved with higher expectations. This type of progressive clinical/observation experiences would then culminate in a student teaching assignment.

Appendix B–3: Recommendations for Classroom Observation Programs

Mathematics and Science Task Force, University of Wisconsin–Green Bay
Julie Harris
March 10, 1999

Here are the items I would like to have a prospective teacher observe before she/he enters the field of Education.

1. Follow a classroom teacher for an entire day and respond to the experience on paper. Here are some of the things she/he should see what a teacher does.

- bring in assignments that were corrected last night
- arriving early to prepare for students
- working with special area teachers (LD, ED, ESL, etc.)
- taking hot lunch, attendance
- behavior modification
- small/large group observation
- giving daily duties to students (calendar, office materials, etc.)
- teacher differences
- board work
- office paperwork
- bulletin boards
- consultation
- questioning techniques and encouraging thoughts
- preparing for each (7) subject areas
- correcting in between (when specials occur)
- sending notes to parents
- contacting a teacher in another class by phone
- working with colleagues on discipline or subject areas
- staff development hours

2. Having a mentor the first few years would be an excellent idea.

3. Observing either an opening or closing to a school year.

Appendix B–4: Recommendations for Classroom Observation Programs

Mathematics and Science Task Force, University of Wisconsin–Green Bay
Wayne Olm
March 10, 1999

Thoughts on Student needs:

I. Observe and describe teaching techniques

II. Observe and describe question and answer techniques

III. Determine Grading standards
   a) Tests value vs. home work grades vs. lab grades
   b) Rubric development?
   c) State (National) standards and benchmarks — applications to curriculum

IV. Scope and Sequence of curriculum:
   - 9th grade – Science to
   - 10th grade – Biology to
   - 11th grade – Chemistry to
   - 12th grade – Physics

   a) What is the basic knowledge—content at each grade level—course—relating to state testing?
   b) High School graduation test?

V. How to use a text book for planning.
   a) Using Science — lecture inquiry labs tests discussions reports—presentations
   b) Total chapters used–how to eliminate what chapters — with or without local curriculum

University and teachers must improve communication between all areas of education. University must find a reward system to help mentor teachers. University must motivate classroom teacher to help their education program. Model the model! Is there a professional code of dress?

Appendix C: Outside Reviewers

SECONDARY MATHEMATICS

Bonnie Berken	Mathematics Department St. Norbert College
Jim Christopherson	Mathematics Department Bay Port High School
John Janty	Mathematics Department Waunakee High School
Dr. Norbert Kuenzi	Mathematics Department University of Wisconsin-Oshkosh
Dr. James Marty	Mathematics Department Waukesha North High School
Pam Plamann	Mathematics Department Green Bay Preble High School

ELEMENTARY MATHEMATICS

Dr. James Marty	Mathematics Department Waukesha North High School
Dr. Jen Szydlik	Mathematics Department University of Wisconsin-Oshkosh

Teachers at Denmark Elementary/Middle School

SECONDARY SCIENCE

Rick Berken	Biology Department Green Bay Southwest High School
Jim Glock	Biology Department Green Bay West High School

SECONDARY SCIENCE – continued

Dan Kirsch	Biology Department Bay Port High School
Steve Krings	Biology Department Green Bay Southwest High School
Scott Liddicoat	Chemistry Department Green Bay Southwest High School
Dr. Brian Merkel	Human Biology Department University of Wisconsin–Green Bay
Sally Quackenboss	Director of Science Education Green Bay Area Public Schools
Ron Thornam	Special Needs Science Teacher Thornton, Colorado

ELEMENTARY SCIENCE

Science Content Leaders, Green Bay School System

Appendix D: Eisenhower Project Abstract

Resources for Learning Science and Mathematics: the Community as a Classroom

K-12 science and mathematics teachers are being challenged to engage their students in addressing important real-world problems. Among those calling for the use of a range of community resources in addressing real-world problems and issues were members of a recent task force at the University of Wisconsin–Green Bay which consisted of University of Wisconsin–Green Bay faculty members and K-12 teachers in area schools.

Among the skills and competencies identified by the task force as vital for those entering K-12 classrooms is the ability to effectively use a wide range of resources — including those that exist in the community — to aid in student learning of science and mathematics. An additional concern that underlies this proposal is an analysis of the performance in science and mathematics by 8th and 10th grade students on last year's Wisconsin Knowledge and Concepts Examination. The large percentage of 8th and 10th grade students performing at the Basic or Minimal levels in both the CESA 7 District and throughout the state of Wisconsin is the cause for this concern, particularly because the percentage continues to increase as students progress through the curriculum.

The primary objective of this proposal is to assist in-service and pre-service science and mathematics teaches at the middle and high school levels in the development of skills and resources which will enable them to effectively engage their students in addressing real-world problems and important societal questions and issues. It is an objective that is shared by the leadership in CESA 7, the local educational agency (LEA) for this proposal.

We plan to achieve the objective of this proposal by assembling project teams that will address specific real-world applications or society issues of relevance to students in Northeast Wisconsin. Each team will consist of at least seven members including a university faculty/staff member, at least one

community/industry representative, four in-service teachers, and a science or mathematics education student. The charge to each team will be to identify and develop instructional materials related to the team's theme that can be used effectively and efficiently in middle and high school classrooms and laboratories. In addition, the instructional materials are to be clearly tied to one or more of the performance standards from "Wisconsin's Model Academic Standards."

Once the instructional materials are tested in classrooms, systematic feedback will be solicited from participating teachers concerning the educational effectiveness of the materials and the curricular context in which they were utilized and tested. A dissemination conference will be held at UW–Green Bay to which CESA 7 teachers will be invited. An additional conference hosted by the Institute for Learning Partnership will be held at UW–Green Bay to share the instructional materials developed as part of this project with a wider audience, to discuss the process involved in producing the instructional materials, and to discuss the implications for teaching and learning of science and mathematics at the middle and high school levels.

In short, the vision shared by all involved with this proposal is that science and mathematics teachers will become catalysts in helping our students understand how the concepts and skills they are learning in these academic subjects prepare them for life in the real world. In turn, it is anticipated that incorporation of real-world applications into science and mathematics instructional activities will provide motivation for learning and lead to enhanced understanding of these academic subjects.

Appendix E: Alignment Task Force Abstract

In December of 1999, Deans Nancy Kaufman and Carol Pollis of the University of Wisconsin–Green Bay organized the Mathematics and Science Alignment Task Force. The Alignment Task Force was charged to "make recommendations to the deans on whether the math and science education curriculum needs to be changed, and if so, how it needs to be changed to ensure that all teacher education graduates in elementary education and secondary math and science can achieve [the competencies proposed by the original Mathematics and Science Task Force]".

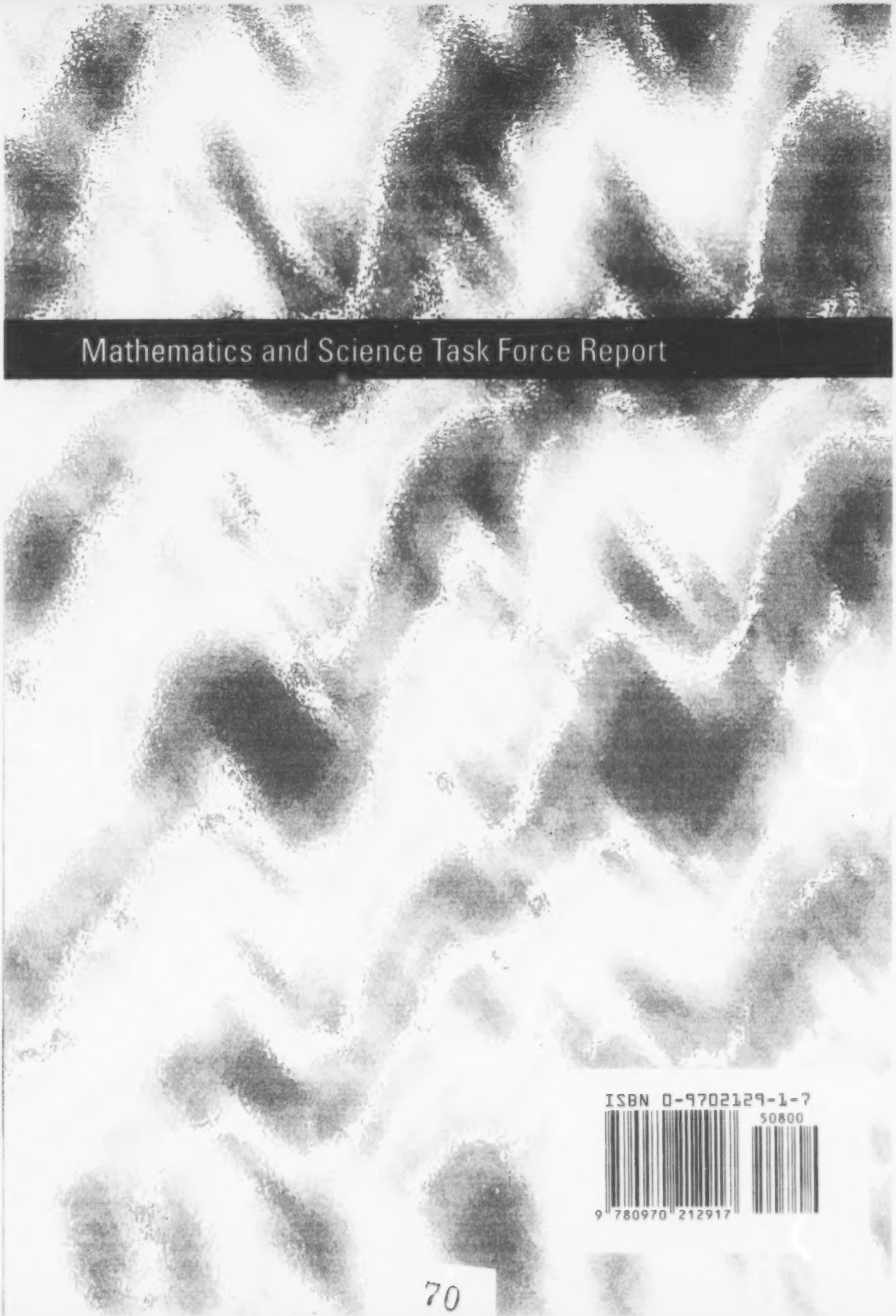
The following individuals were appointed to the Alignment Task Force: Angela Bauer-Dantoin, assistant professor of Human Biology at UW–Green Bay, who served as chairperson of the Alignment Task Force; Michael Berken, mathematics teacher, Pulaski High School; Greg Davis, associate professor of Natural and Applied Sciences at UW–Green Bay; Julie Harris, teacher, Webster Elementary School, Green Bay; Ted Korithoski, associate professor of Teacher Education at UW–Green Bay; Mary Kornely, teacher, Denmark Elementary School; Brian Merkel, assistant professor of Human Biology at UW–Green Bay; Wayne Olm, biology teacher, Green Bay Preble High School; and Thomas Van Koevering, professor of teacher education at UW–Green Bay.

To determine the extent to which the competencies developed by the original Mathematics and Science Task Force are covered by the University's current teacher education curriculum, Alignment Task Force members reviewed relevant course syllabi; interviewed mathematics, science and education faculty; solicited comments from recent graduates of the teacher education program at UW–Green Bay; and obtained feedback from cooperating teachers who have worked with UW–Green Bay teacher education students during their field experiences.

Using this information, members of the Alignment Task Force determined that with few exceptions, the current curriculum does a thorough job of addressing competencies pertaining to mathematics and science content and

educational theory. However, curriculum deficiencies were noted in coverage of competencies pertaining to technology in the classroom, inquiry-based learning, standards-based education, and educational partnerships. Recommendations were made to revise teaching methods courses so that they adequately prepare future teachers for the first three of these issues. The Alignment Task Force also recommended that a course on educational partnerships be made mandatory for teacher education students to address deficiencies in this area. Finally, the task force made several recommendations for the restructuring of student field experiences to ensure that teacher education students receive adequate mentorship as they move from theory to practice in the classroom.

With the incorporation of the suggested changes into UW–Green Bay's teacher education curriculum, it is anticipated that students will be given ample opportunity to gain the competencies and skills that are necessary for becoming effective teachers of mathematics and science in K-12 classrooms.



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